

MODEL 2405

Limits Comparator

Instruction Manual

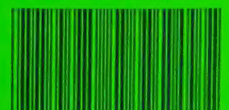
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October 1983

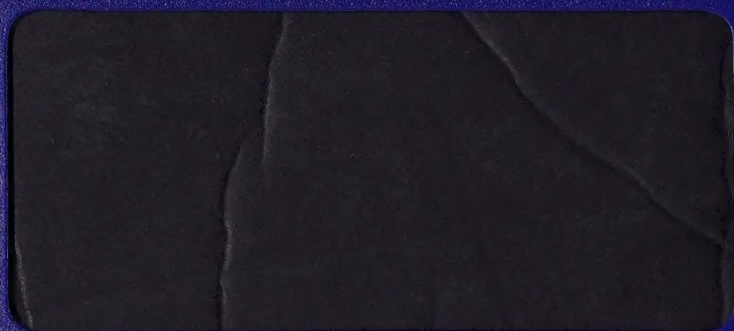
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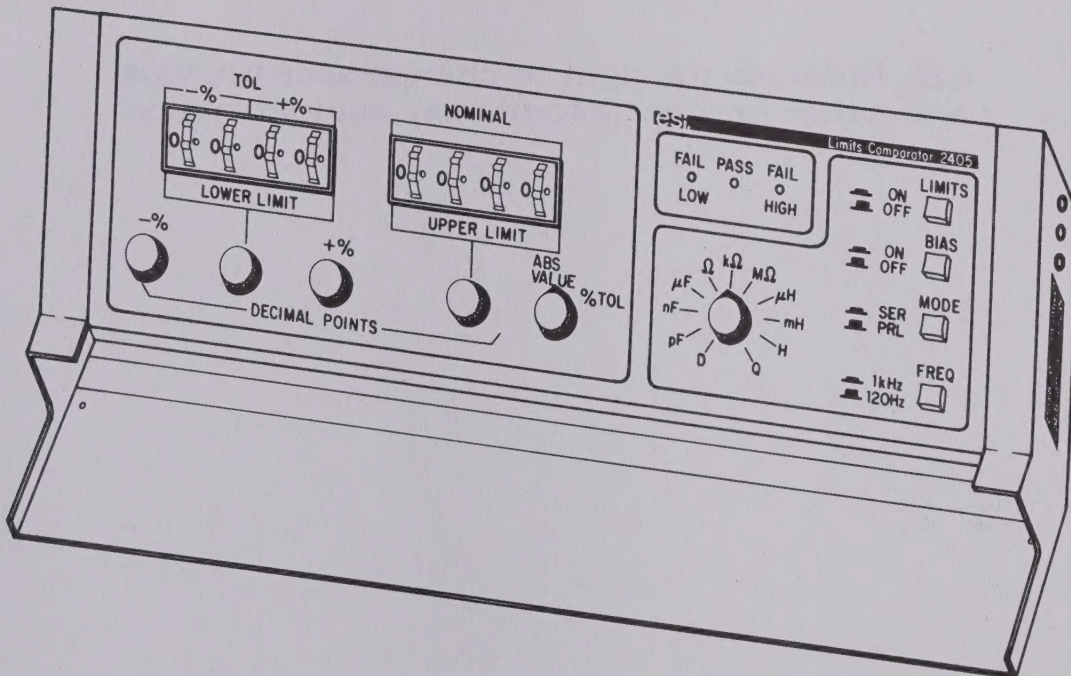
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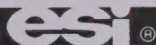
Instruction Manual

Part Number 52734A

October 1983



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D A M A G E I N T R A N S I T

The instrument should be thoroughly inspected immediately upon receipt. If the instrument fails to operate properly, or if damaged in any way, a claim should be made against the carrier. A full report of the damage should be made, including the type and serial number of the instrument, and forwarded to Electro Scientific Industries, Inc., or your local agent. Upon receipt of this report, you will be advised of the disposition of the instrument for repair or replacement.

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SECTION S

SAFETY INFORMATION

S.1 INTRODUCTION

Read and follow the CAUTIONS and WARNINGS in this manual. They are designed to emphasize safety during all phases of operation and maintenance.

S.2 SAFETY TERMS AND MEANINGS

CAUTION -- Statements identify conditions or practices that could result in damage to the equipment or property.

WARNING -- Statements identify conditions or practices that could result in personal injury or loss of life. In addition, damage to the equipment or other property may result.

DANGER -- Indicates a personal injury hazard is near the marking.

S.3 THE FOLLOWING WARNINGS APPEAR IN THIS MANUAL

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS AND THE PERFORMANCE CHECKS, UNLESS YOU ARE QUALIFIED TO DO SO.

SECTION 1

DESCRIPTION

1.1 INTRODUCTION

The ESI Model 2405 Limits Comparator is a general purpose PASS/FAIL component sorting accessory designed for use with the ESI Model 2400 LRC Bridge. It connects electrically to the LRC Bridge, via a flat cable and connector. It is physically attached to the LRC Bridge so that both instruments may be handled and transported as one.

The PASS/FAIL limits are set using two banks of thumbwheel switches. These may be used either to set absolute value limits or positive and negative percentage tolerances around a nominal value.

Control of the LRC Bridge functions is transferred to the Limits Comparator, when the latter is in use. Otherwise the LRC Bridge will function normally. Controls on the Limits Comparator are all of the latching type, so that power can be removed without loss of settings. The Limits Comparator provides one additional function, not available on the LRC Bridge. This is for the measurement of quality factor (Q).

The PASS/FAIL result is indicated by three LEDs, two red and one green, situated on the front panel. The red LEDs indicate FAIL HIGH and FAIL LOW, the green LED indicates PASS. The state of the three LEDs is electrically accessible via three 3.5mm phone jacks. These may be used for external indication or control of a component handler.

1.2 TECHNICAL SPECIFICATIONS

Modes	:	Absolute value or nominal value with % tolerance
Limits Setting Precision	:	4 digits for value, 2 digits for % tolerance
Measurement Ranges	:	D, picofarad, nanofarad, microfarad, ohm, kilohm, megohm, microhenry, millihenry, henry, Q
Equivalent Circuit	:	Series or Parallel
Test Frequencies	:	120Hz or 1kHz
Bias	:	2VDC
Basic Accuracy	:	+/- 0.25% of reading +/- 1 digit
Current Rating of Contact Closure Outputs	:	0.5A
Power Rating of Contacts	:	10W
Max. Voltage across Contacts	:	100V
Operating Dimensions of Limits Comparator	:	445mm x 140mm x 50mm (17.8 in. x 5.6 in. x 2 in.)
Weight	:	4.2kg Net (9.3 lb)
Overall Dimensions of Limits Comparator and Databridge Combination	:	445mm x 386mm x 185mm (17.8 in. x 15.4 in. x 7.4 in.)
Weight of Limits Comparator and LRC Bridge Combination	:	9.8kg (21.6 lb)

For full details of the technical performance of the Model 2400 LRC Bridge, please consult the Operation Manual for that instrument.

SECTION 2

OPERATING INSTRUCTIONS

2.1 INTRODUCTION

This section of the manual contains information on the correct operation of the Model 2405 Limits Comparator. It is recommended that the contents of this Section are read and understood before attempting to operate the instrument. Should any difficulties arise during operation, please contact:

Electro Scientific Industries, Inc.
13900 N.W. Science Park Drive
Portland, Oregon 97229

Telephone: (503)641-4141
Telex: 4742064
Fax: (503)643-4873

2.2 PACKING

The Model 2405 Limits Comparator was shipped in a carton especially designed to provide adequate protection. On receipt, please inspect the instrument for possible transit damage.

If reshipment of the instrument is ever necessary, it is advisable to use the original packing. If this is not available, a new carton packing can be obtained from ESI.

2.3 PREPARATION FOR USE

2.3.1 Installation of LRC Bridge to Limits Comparator Interface Card

The 2405 Limits Comparator is intended for use only with a Model 2400 LRC Bridge. Before attempting to fit the Limits Comparator to the LRC Bridge, ensure that the Interface card has been installed in the Model 2400 by observing the presence of the interface connector on the side of the bridge opposite the AC power receptacle. If the LRC Bridge does not contain the interface card, then contact your nearest ESI representative or the ESI Instruments sales office. A field installation kit is available.

The Field Installation Kit is comprised of:

1. Interface card with attached flat cable and connector SK2.
2. EPROM (IC404).
3. Flat cable with connectors.
4. A set of hardware for interface card to chassis attachment.
5. A set of hardware for attaching connector SK2 to chassis.

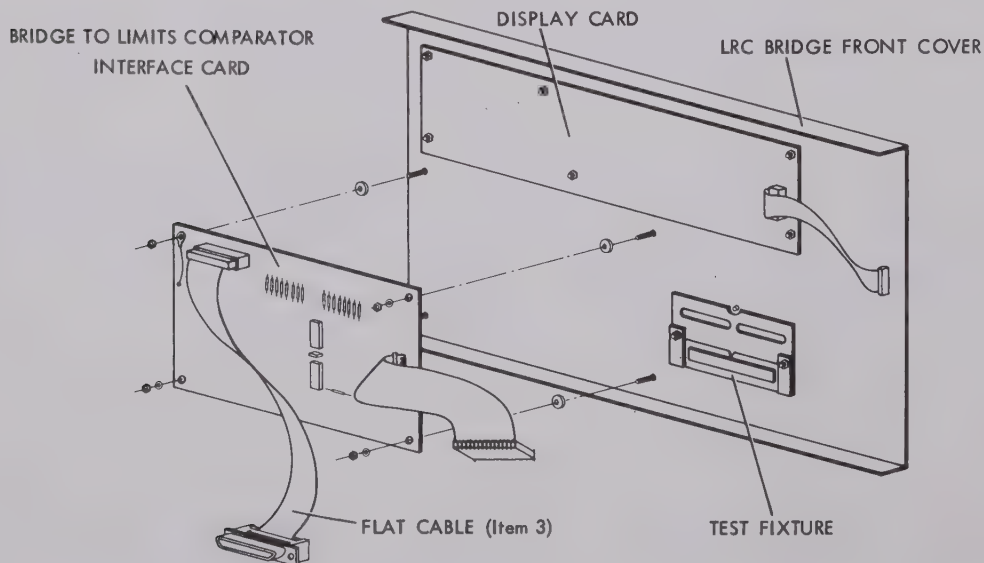


Figure 2-1. Location of the LRC Bridge to Limits Comparator Interface Board

The following procedure is to be used when installing the interface board in the Model 2400. Refer to Figure 2-1.

- STEP 1. Remove the six screws holding the cover on the chassis using a 2.5mm hex key.
- STEP 2. Disconnect the flat cable connector which attaches the display card to main printed circuit card.
- STEP 3. Remove the ground lug from the main printed circuit card to the test fixture either by unsoldering it or by removing the retaining nut. If the nut is removed, temporarily replace it after removing the lug to prevent the test fixture push bar falling out of its housing.
- STEP 4. Place cover face down on a bench with the display card on top.
- STEP 5. Place the spacers on the four studs below the display card and to the left of the test fixture.
- STEP 6. Place the interface card over the studs so that the flat cable on the edge of the printed circuit card is next to the test fixture.
- STEP 7. Place the ground lug over the stud next to the flat cable connector labeled SK2.
- STEP 8. Fit the washers and nuts and secure the printed circuit card to the cover.
- STEP 9. On the chassis containing the main printed circuit board remove the cover plate on the side of the chassis opposite the AC power receptacle. Retain the cover plate for future use if required.

- STEP 10. The flat cable (item 3) has two connectors one blue, one grey. The grey connector should be attached in the position from which the cover plate was removed. The connector should protrude through the chassis from the inside and should be attached by means of the nuts and washers and tapped hexagonal studs included. The tapped studs are installed on the outside to enable the connector from the Limits Comparator to be secured to the LRC Bridge.
- STEP 11. Plug the EPROM (item 2) into the socket in location IC404. Note the position of pin 1.
- STEP 12. Carefully hold the front cover in such a position that the flat cable on the interface card can be connected to connector PL2 on the main card. Note the keying to ensure correct orientation.
- STEP 13. Connect the blue end of the flat cable referred to in paragraph 10 to connector PL1 on the interface card.
- STEP 14. Reconnect the fourteen pin flat cable connector display card connector disconnected in STEP 2.
- STEP 15. Reconnect the ground lug disconnected in STEP 1.
- STEP 16. Replace the cover ensuring that all cables are clear of test fixture and large capacitors (C501 and C502).
- STEP 17. Reattach the cover.

To check operation, perform the tests contained in the Limits Comparator manual.

2.3.2 Attachment of the Limits Comparator to the LRC Bridge

To join the Limits Comparator to a 2400 LRC Bridge, first lay the LRC Bridge flat, with the handle lying near the front edge of the instrument. (The LRC Bridge should be switched off and the AC power, cable unplugged from the side.) Raise the rear of the LRC Bridge and gently slide the Limits Comparator into position, as shown in Figure 2-2. Next attach the assembly by tightening the securing screws on the bottom of the Limits Comparator, using the hex wrench supplied. (Avoid applying excessive torque.) Lift the instrument and swing the handle under as shown in Figure 2-2.

Connect the Limits Comparator flat cable plug to the socket at the rear, righthand side of the LRC Bridge. This may be secured by tightening the two attachment screws.

Reconnect the AC power cable to the LRC Bridge. The Limits Comparator requires no AC power connection, as it is powered from the LRC Bridge.

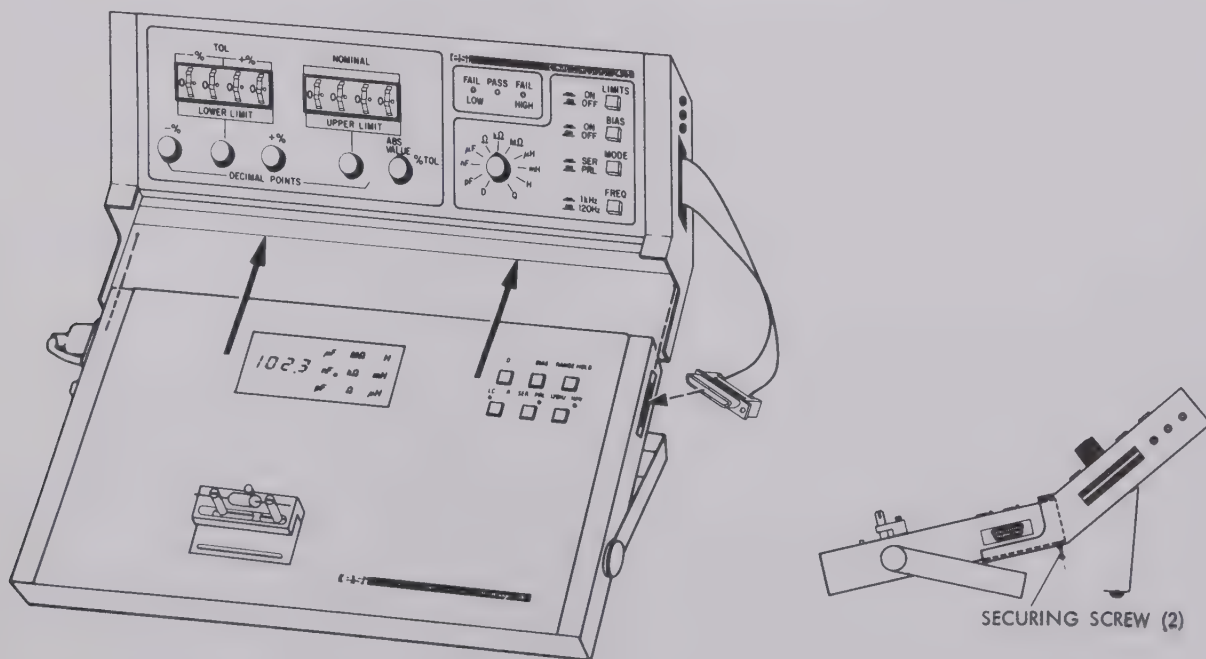


Figure 2-2. Attachment of the Model 2405 Limits Comparator to Model 2400 LRC Bridge

2.4 CONTROLS

The controls, as shown in Figure 2-3, consist of six rotary switches, four latching pushbutton switches and two banks of four thumbwheel switches. When in use, the Limits Comparator settings override the auto-ranging and auto-function systems in the LRC Bridge, but the user prompts are retained. The functions for each control will be described in the following paragraphs.

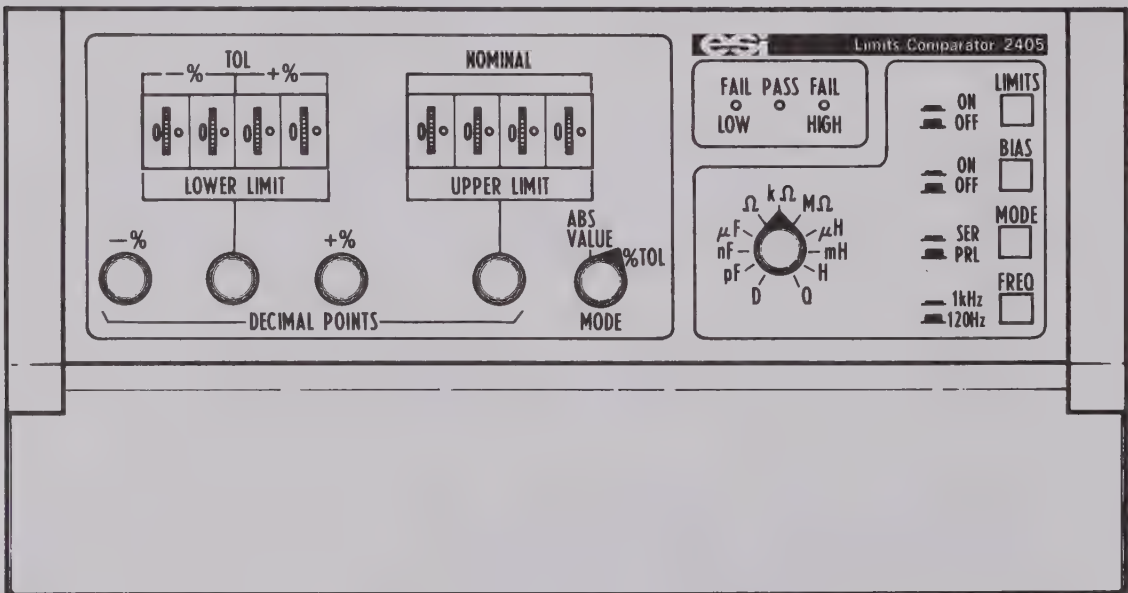


Figure 2-3. Model 2405 Front Panel

2.4.1 Pushbutton Switches

The four latching pushbutton switches are situated in a vertical line on the righthand side of the Limits Comparator front panel. They will be described starting at the top. For full information on the functions they control, consult the Model 2400 LRC Bridge Operation Manual.

Limits (ON/OFF)

This switch is used to start the Limits Comparator operating. With the switch in the OFF position, the LRC Bridge functions normally and the Limits Comparator controls have no effect. With the switch depressed (ON), control is transferred to the Limits Comparator and the LRC Bridge controls become inoperative.

Bias (ON/OFF)

This is used to apply a 2VDC bias voltage, for use in testing electrolytic capacitors. On application or removal of the bias voltage, a settling time of about 45 seconds is required. During this time the LRC Bridge display will read bias. The Bias LED indicator on the LRC Bridge indicates that the bias is ON when the switch is depressed.

Mode (SER/PRL)

This switch is used to select the equivalent circuit mode. It has, therefore, the same functions as the SER/PRL switch on the LRC Bridge. The SER/PRL indicator LEDs on the LRC Bridge, indicate the state of this switch when the Limits Comparator is in use.

Frequency (120Hz/1kHz)

This switch is used to set one of the two available measurement frequencies. The 120Hz/1kHz indicator LEDs, on the LRC Bridge, indicate the test frequency selected, when the Limits Comparator is in use.

2.4.2 Rotary Switches

The front panel contains six rotary switches. Four of these are used for setting decimal points on the limit values. The other two are used for selecting the limits mode (Absolute Value or % Tolerance) and the measurement range.

Measurement Range

This eleven position switch is used to set the measurement range for the LRC Bridge. There are nine component value positions equivalent to the positions on the LRC Bridge's range display panel. When the Limits Comparator is ON, the LEDs on the LRC Bridge panel represent the position of the range switch. The two remaining positions on this switch are to select Q or D ($1/Q$). Quality factor (Q) is not available on the LRC Bridge when used without the Limits Comparator.

When Q or D are selected, the range LEDs on the LRC Bridge are all extinguished and the D LED is lit.

Limits Mode

The Limits Mode switch has two positions, Absolute Value (ABS VALUE) and Percentage Tolerance (% TOL). In the ABS VALUE position the pass/fail limits are set as absolute values within the units selected by the Measurement Range switch. In the % TOL mode the pass/fail limits are set as a positive and a negative percentage of the nominal value selected by the thumbwheel switch labeled NOMINAL.

Decimal Point (UPPER LIMIT/NOMINAL)

This switch is used to select one of the four available decimal point positions on the righthand bank of thumbwheel switches. These switches are used to select either the upper value or the nominal value of limit.

Decimal Point (+% TOL)

This switch (the third from the left) is used only in the % TOL mode. In this mode, the righthand pair of digits, on the lefthand bank of thumbwheel switches, are used to select the positive percentage tolerance. Two possible decimal point positions can be selected by this switch.

Decimal Point (LOWER LIMIT)

This switch is used to select one of the four available decimal point positions on the lefthand bank of thumbwheel switches. It is only used in the VALUE mode to set the LOWER LIMIT.

Decimal Point (-% TOL)

This switch has an identical function to that described in Decimal Point (+% TOL) above, but covers the decimal points for the lefthand pair of digits. This switch is used to set the negative percentage tolerance.

2.4.3 Thumbwheel Switches

The righthand set of thumbwheel switches are used for selecting either the UPPER LIMIT when in the ABS VALUE Mode or NOMINAL VALUE when in the % TOL Mode. Each digit in the bank can be increased or decreased by rotating the adjacent thumbwheel.

The lefthand set of switches has two functions. When the Limits Comparator is operated in the VALUE Mode, selected by the LIMITS Mode switch, this set of switches defines the LOWER LIMIT threshold, in a similar manner to that of the righthand bank. However, in the % TOL Mode, the lefthand set of switches are used to select the positive and negative percentage tolerance limits. To accomplish this, the switches are divided into two pairs. The lefthand pair of digits then represent the negative tolerance value and the righthand pair represent the positive tolerance value.

2.5 INDICATORS

2.5.1 Pass/Fail

The PASS/FAIL indicators consist of three LEDs, one green and two red. When the green LED lights, the value of the component under test falls within the pass band defined by the higher and lower limits (or positive and negative percentage tolerances). When the component value lies below the lower limit, the FAIL LOW, red LED will light. When the value lies above the higher limit, the FAIL HIGH, red LED will light. Occasionally, the value of the measured component may lie very close to one of the limits. It is possible, in this case, for the uncertainties of measurement to prevent a confident PASS/FAIL decision to be made. In this case, all three LED's will remain extinguished. The user should adopt a policy of acceptance or rejection in this case, dependent on the application.

2.5.2 Decimal Point

The decimal point positions, on each set of thumbwheel switches, are indicated by a red LED located between each pair of digits.

2.6 CONNECTORS

2.6.1 Phone Jacks

Three 3.5mm phone jacks are provided at the rear, righthand side of the Limits Comparator. Each of these relates to one of the three PASS/FAIL indicators. An isolated contact closure is provided across each of the phone jacks. The state of the contact closure corresponds to the state of the PASS/FAIL indicator to which it refers. (LED on = contact closed.) These contacts may be used to provide additional external PASS/FAIL indication, or to operate a parts handler.

2.6.2 Flat Cable and Connector

The flat cable and connector is used to provide an electrical connection between the LRC Bridge and the Limits Comparator. Power, control, and logic signals pass along this cable. When connected to the LRC Bridge, the connector should be secured using the two attachment screws.

2.7 OPERATION

After preparing the Limits Comparator and LRC Bridge for use, as described in Section 2.3, turn on the LRC Bridge using the ON/OFF switch located adjacent to the AC power connector.

With the LIMITS pushbutton in the OFF position, the LRC Bridge should function normally. Please refer to the 2400 LRC Bridge Operation Manual for detailed information on the operation of the LRC Bridge.

To apply power to the Limits Comparator, set the LIMITS pushbutton to the ON position. The units, in which the measurement is required, should now be set on the Measurement Range switch. Keep in mind the possible positions of the decimal point to achieve the best resolution. It is usually desirable to use as many of the display digits as possible. Use the lowest range in which the nominal value of the component can be expressed.

For example:

Measure 100 as 100.0 on the ohm range,
not as 0.100 on the kilohm range.

The upper and lower PASS/FAIL limits can now be set. For convenience, the Limits Comparator provides the option of setting these limits either as absolute values (ABS VALUE) or a nominal value with positive and negative tolerance limits (% TOL). To set the limits as absolute values turn the Limits Mode rotary switch to ABS VALUE then simply set the right thumbwheel switch to an upper value and the lefthand thumbwheel switch to a lower value. To set the Percentage Tolerance Mode turn the Limits Mode Switch to the % TOL and set the righthand thumbwheel switch to the nominal value desired. To set the percentage limits around the nominal value, set the two left digits of the left thumbwheel switch to a negative value and set the right two digits of the same thumbwheel switch to a positive value. For both the Absolute Value Mode and the Percentage Tolerance Mode make sure that the Measurement Range switch is set to a position that gives the most accurate reading. Decide which mode to use and set the pass/fail limits. At this point, if no component has been connected for measurement, one of the red, FAIL LEDs will light, depending on the parameter being measured.

Insert the component to be measured into the jaws of the LRC Bridge. The LRC bridge will indicate the measured value and the Limits Comparator will indicate in which of the three pass/fail bands this value lies. The LRC Bridge repeats its measurement cycle about twice per second. The decision making algorithm looks for two consecutive similar readings before indicating the result.

2.8 USER PROMPTS

The LRC Bridge user prompt system remains in operation when the Limits Comparator is ON. For a detailed description of user prompts, consult the Model 2400 LRC Bridge Operation Manual.

There is an additional prompt system which has been provided to warn the user of illogical settings of the limit values. When the two dashed lines between L and H are in line with each other, the limits are set equal to one another. In this condition the LRC Bridge will display the following symbols: L--H indicating an error in the limits setting. When the left line, adjacent to the L, is above the right line, the lower limit is set above the upper limit. The LRC Bridge will display the following symbols: L-H indicating an error in the limits setting. When the limits are set correctly, the display will show the measured value.

SECTION 3

THEORY OF OPERATION

3.1 CIRCUIT DESCRIPTION

To follow this circuit description, reference should be made to Section 5.1 Main Circuit Assembly.

The connector labeled PLA is the flat cable connector on the output cable. Power is supplied from the LRC Bridge to the Limits Comparator via this cable. Pin 9 is +5V and Pin 21 is 0V. Pins 1 and 13 go to chassis ground. Pins 4, 5, 15, 16, 17, 14, 2, and 3 are an eight bit data bus, used to transmit the position of the various switches to the LRC Bridge via its internal interface. Each of the switch contacts is connected to one of these bus lines, generally via a diode. The switches are divided into eight sets which are scanned in succession, each measurement cycle, when the Limits Comparator is on. The selection of the switch set being interrogated is determined by the address lines on Pins 6, 7, and 8.

The three binary address lines go to the inputs of IC1. The LSB, input A on IC1, is on pin 8. IC1 decodes the address and puts a +5V logic 1 onto the appropriate switch set. On the circuit diagram, the numbers 0 to 7, associated with the internal switches within IC1, indicate, in decimal, the numerical code required to close each switch.

The Limits ON/OFF switch has two contact sets. One of these (SWA/B) is used to control the +5V supply to the Limits Comparator circuitry, the other (SWA/A) is used to signal to the LRC Bridge (via data line Z0 and address code 0) that the Limits Comparator is ON or OFF. Note that when connector PLA is disconnected from the LRC Bridge, the latter interprets this state as Limits Comparator OFF.

The PASS/FAIL result is passed to the Limits Comparator via Pins 18, 19, and 20. These directly control the three PASS/FAIL/LEDs, and the relays which provide contact closure outputs.

SECTION 4

MAINTENANCE

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS AND THE PERFORMANCE CHECKS, UNLESS YOU ARE QUALIFIED TO DO SO.

This section of the manual contains information on service, general maintenance, performance checks, and troubleshooting. The performance checks are included as a preventive maintenance aid and should be executed when it is necessary to verify that the Limits Comparator and LRC Bridge system is operating correctly.

The following items are recommended for maintenance and service. If the specified equipment is not available, other equipment having equivalent specifications may be substituted.

Table 4-1. Equipment for Maintenance and Service

<u>DEVICE</u>	<u>MINIMUM SPECIFICATION</u>	<u>RECOMMENDED EQUIPMENT</u>
Resistor 2 kilohm	+/- 0.05% (+/- 10ppm/degree C)	ESI Model DB877 or equivalent
3.5mm Phone Plug	Not critical	
Digital Multimeter	DC and AC volts to 0.1% ohms	
Oscilloscope	50MHz, x 10 probe	

4.1 PERFORMANCE CHECKS

A sequence of performance checks for the LRC Bridge is included in the Model 2400 LRC Bridge Operation Manual and these should be executed before carrying out the checks involving the Limits Comparator.

STEP 1. Turn on the LRC Bridge. Make sure no component is in the test fixture. Set the Limits Comparator to ON and the remaining switches to the following states:

BIAS	:	OFF
MODE	:	PRL
FREQ	:	1kHz
RANGE	:	kilohm
LIMITS MODE	:	VALUE
UPPER LIMIT	:	2.200
LOWER LIMIT	:	1.800

The LRC Bridge should indicate the symbols 'or' (over-range) and the Limits Comparator LEDs should be unlit. The Digital Multimeter should be connected via a short cable to the 3.5mm phone jack. Using this, on the ohms range, check that the state of the contact closure outputs is correct. Contacts connected to the phone jacks are normally open when the PASS/FAIL indicates LEDs are extinguished.

STEP 2. Connect the 2 kilohm standard resistor to the test fixture on the LRC Bridge. Check that the LRC Bridge reading is between 2.007 kilohms and 1.993 kilohms.

The green PASS LED should now be lit. Check again that the contact closure outputs are in the correct state.

STEP 3. Increase the LOWER LIMIT setting on the lefthand thumbwheel switch until the PASS LED extinguishes and the FAIL LED lights. That point should be at approximately 2 kilohms. As the LOWER LIMIT setting is increased further all LEDs will extinguish and the prompt noting that the LOWER LIMIT setting exceeds the UPPER LIMIT setting.

STEP 4. Continue to increment the LOWER LIMIT setting until it reads 2.100 kilohms. At this point the red FAIL LOW LED should light. Check again that the contact closure outputs are in the correct state.

STEP 5. Now set the following:

LIMITS MODE	:	% TOL
-% TOL	:	5.0
+% TOL	:	5.0
NOMINAL	:	2.000

The green PASS LED should light.

STEP 6. Operate the % TOL decimal point switches and check that each of the decimal point positions, on the lefthand set of thumbwheel switches can be set. Operate the NOMINAL decimal point switch and repeat for the righthand set of switches.

STEP 7. Set the following:

LIMITS mode	:	VALUE
-------------	---	-------

Operate the LOWER LIMIT decimal point switch and check that each of the decimal point positions can be set.

STEP 8. Operate the FREQ, MODE, and BIAS pushbuttons and check that the appropriate indicator LEDs on the LRC Bridge switch panel light.

4.2 ACCESS INFORMATION AND PRINTED CIRCUIT CARD REMOVAL

Use the following procedure to gain access to the interior of the Limits Comparator and to remove the printed circuit card for servicing. Refer to Figure 4-1 for printed circuit card removal.

- STEP 1. Remove the Limits Comparator from the LRC Bridge in the reverse order to that described in Section 2.3.
- STEP 2. Remove the grey caps from each of the six rotary switch knobs. Release the collet in each knob by loosening the screw under each grey cap. Remove all six knobs.
- STEP 3. Remove and retain the six front panel screws located on the front and rear edges of the top panel. Use a 2.5mm hex wrench.
- STEP 4. Lift the top panel off the main part of the case.
- STEP 5. Unscrew and remove the two phillips headed screws which hold the clamp, for the external flat cable, onto the wall of the case.
- STEP 6. Remove the three 10mm nuts used to secure the three phone jacks to the righthand side of the case.
- STEP 7. Remove the ten nuts which secure the printed circuit card to the mounting studs. Note that two of these nuts are also used to secure the pushbutton assembly.
- STEP 8. Lift the printed circuit card clear of the case, ensuring that the phone jack assembly releases from the side panel. Thread the external flat cable through the hole in the side of the case. The clamp need not be removed from the cable.

STEP 9. Reassemble in the reverse order. When mounting the pushbutton assembly, ensure that the buttons align properly with the square holes in the front panel, before tightening the assembly nuts.

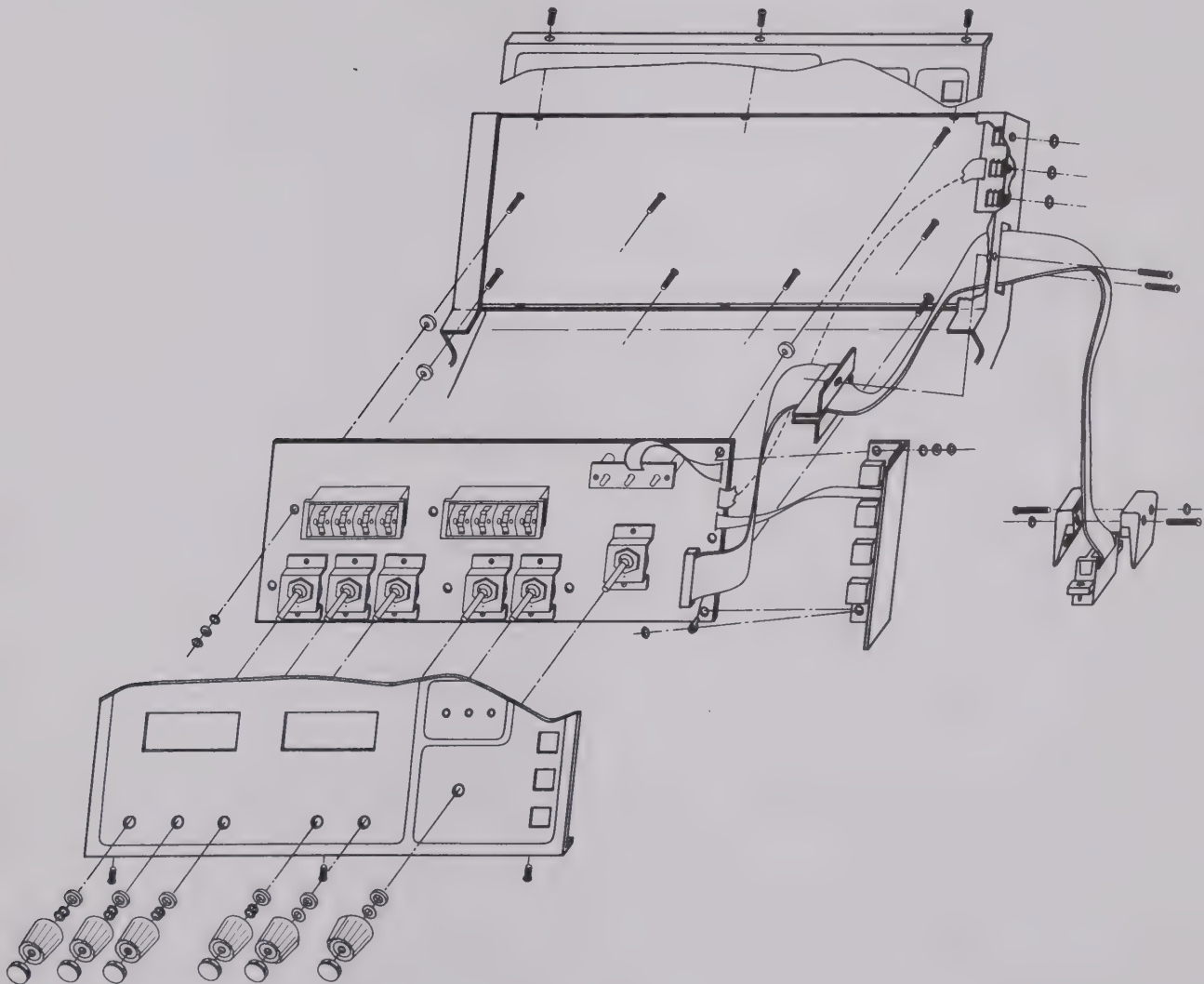


Figure 4-1. Model 2405 Exploded View

4.3 TROUBLESHOOTING

The following section provides possible fault symptoms, together with troubleshooting suggestions.

1. Failure to Turn ON.

Symptom:

- All LEDs blank, LRC Bridge functions normally.

Likely Failure:

- Conductor failure (flat cables).
- Switch contact failure.

Action:

- Check +5V supply reaching pole of SWA/A via flat cables.
- Check operation of SWA.

2. Limits Comparator turns ON, but fails to respond to switch operation.

Symptom:

- Operation of any switch causes no response by LRC Bridge

Likely Failure:

- Conductor Failure (flat cables).
- Switch contact failure.

Action:

- Check for signals on address lines to IC1 (Pins 9,10,11).
- Check for +5V on IC1 (Pins 3 and 16).
- Replace IC1.

3. One switch position, on one or two switches is incorrect.

Symptom:

- Limits do not set up correctly or required measurement conditions cannot be achieved.

Likely Failure:

- Switch contact failure.
- Semiconductor failure (diodes and IC1).

Action:

- If a pair of switches on the same address is involved (e.g. SW1L1 and SW1), then check appropriate diodes (e.g. D28 to D31 and D44 to D47) using resistance tester.

- If only one switch is involved check switch contacts and diodes, using resistance tester.

4. Decimal Point LEDs fail to respond.

Symptom:

- LED fails to light when decimal point position is selected.

Likely Failure:

- Switch contact failure.
- Semiconductor failure (diodes and IC1).

Action:

- Check volts on relevant LED, with that decimal point selected.
- If present, LED or wiring should be checked/replaced.
- If not present, check switch contacts.

5. Pass/Fail LEDs do not light.

Symptom:

- One or more of the Pass/Fail LEDs fail to light as expected.

Likely Failure:

- Conductor failure (flat cables).
- Switch contact failure.

Action:

- Check operation of relay contacts; if this is correct then check wiring between main card and LED assembly. Check the LED.
- If relay also fails to respond, the fault may be in the flat cable or connector (pins 10, 19, and 20).

6. Relays fail to operate.

Symptom:

- Limits Comparator operates normally but, contact closure outputs do not follow the pass/fail LEDs.

Likely Failure:

- Conductor failure (flat cables).
- Relay failure.

Action:

- Check connections to phone jack assembly.
- Check correct operation of relay.

7. General Notes

It is possible to check the operation of the Limits Comparator when it is disconnected from the LRC Bridge. Apply a 5V supply, to pins 9 and 21 of the flat connector, and either 0V or +5V to each of the three address pins (6, 7, and 8). It is now possible to trace the selection of each switch and check that the appropriate code appears on the data bus lines Z0 to Z7, for each switch position. Table 4-2 indicates the code for each position of each switch.

Please note that the correct operation of the Limits Comparator system depends not only on the Limits Comparator, but also on the interface circuit card located in the LRC Bridge. If no faults in the Limits Comparator can be found, but the system does not function, the fault is probably associated with this circuit card.

Table 4-2. Address and Data Decoding for All Switch Positions

ADDRESS (CBA)	DATA BUS							
	7	6	5	4	3	2	1	0
0	0	DP (-%TOL) XX. (X.X)	DP (+%TOL) XX. (X.X)	LIM MODE TOL (VAL)	FREQ 1kHz (100HZ)	EQUIV CCT SER (PAR)	BIAS ON (OFF)	LIMITS ON (OFF)
1	0	0	0	0	XXXX.	DP LH XXX.X	VAL XX.XX	X.XXX
2	0	0	0	0	XXXX.	DP RH XXX.X	VAL AND %TOL XX.XX	X.XXX
3	D	C	LSD RH B	A	D	LSD C	LH B	A
4	D	C	D3 RH B	A	D	D2 C	LH B	A
5	D	C	D2 RH B	A	D	D1 C	LH B	A
6	D	C	MSD RH B	A	D	MSD C	LH B	A
7	RANGE SW See Table							

Table 4-3. Coding for Range Switch

POSITION	BITS SET							
	D0	D1	D2	D3	D4	D5	D6	D7
Q								
μH	X							
mH		X						
H			X					
Ω				X				
kΩ					X			
MΩ						X		
pF	X						X	
nF		X					X	
μF			X				X	
D								X

SECTION 5
PARTS LIST AND DIAGRAMS

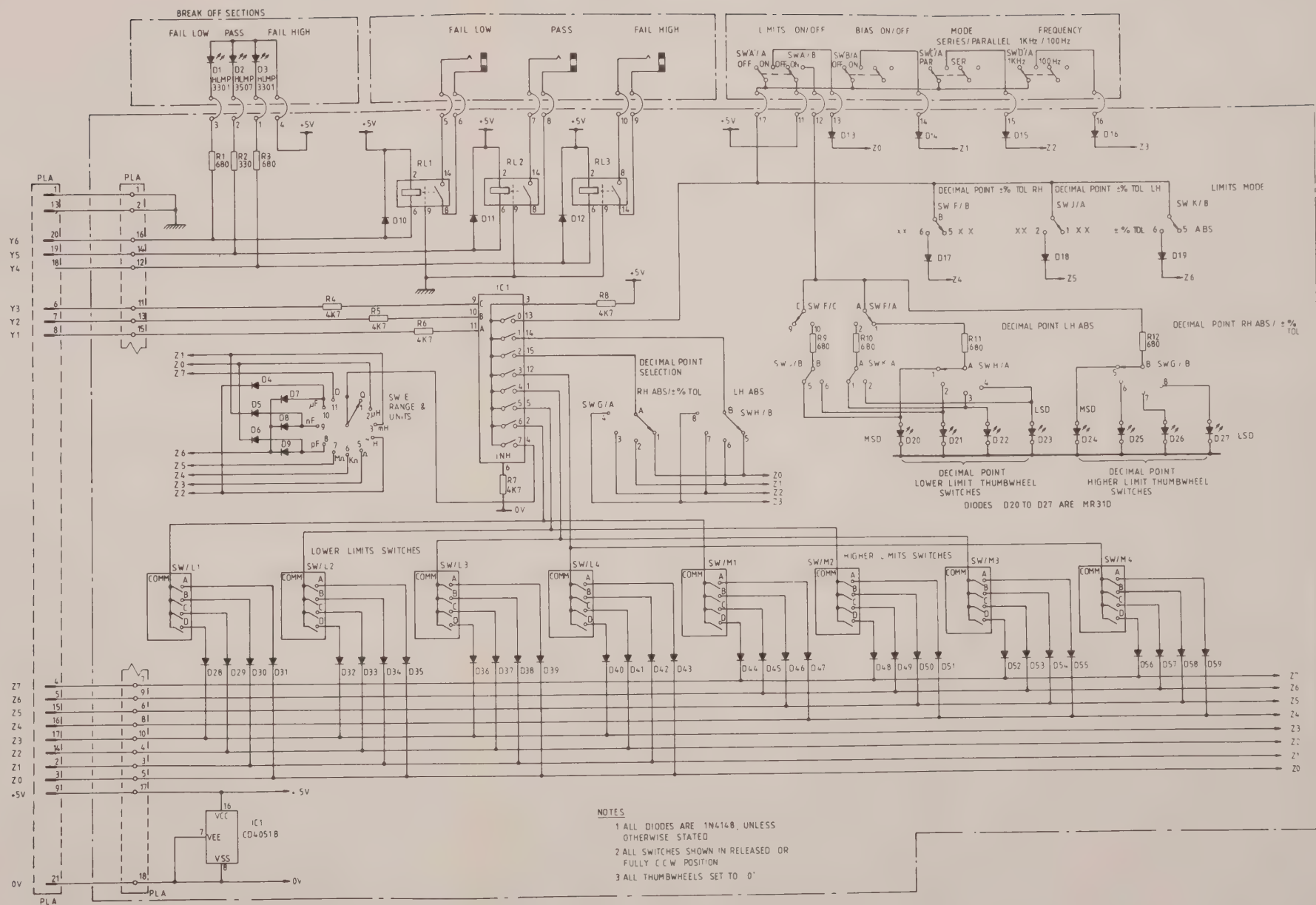
5.1 MAINFRAME PARTS

<u>CIRCUIT NO.</u>	<u>DESCRIPTION</u>	<u>ESI PART NO.</u>
	Assy, Case W/Foot	53148
	Assy, Cover-Top	53146
	Ckt Assy, Interface Board	53145
	Cable Assy, Interface to Bridge	53182
	Knob, Blk W/Cap	53203
	Knob, Blk Pointer W/Cap	53205

5.2 MAIN CIRCUIT CARD

<u>CIRCUIT NO.</u>	<u>DESCRIPTION</u>	<u>ESI PART NO.</u>
SW E	Rotary Switch, 12 Position (Modified)	53518
SW F,G,H,I,K	Rotary Switch, (Modified)	53157
SW	Thumbwheel Switch Assy.	53151
SW A,B,C,D	Push Button Switch Assy.	53510
	Interface Cable Assy.	53247
	Phone Socket	53205
D1,D3	LED, red, HLMP-3301	53161
D2	LED, green, HLMP-3507	53168
D20-D27	LED, red, Mil 31	53169
D4-D19,D28-D59	Diode, 1N4148	52963
IC1	IC, CD4051B	40841
R4-R8	Resistor, 4.7 kilohm, 5%	
R1,R3,R9-R12	Resistor, 680 ohm, 5%	
R2	Resistor, 330 ohm, 5%	
RL1,RL2,RL3	Relay, Hamlin HE721A0500	24804
SW PCB	Flat Cable, Molex 7234/07	
Phone Skt. PCB	Flat Cable, Molex 7234/06	
LED PCB	Flat Cable, Molex 7234/04	

NOTE: Parts without ESI numbers are commonly available as described in the parts list.



e|s|i Model 2405 Limits Comparator 10/83

5.3 INTERFACE CIRCUIT CARD

<u>CIRCUIT NO.</u>	<u>DESCRIPTION</u>	<u>ESI PART NO.</u>
R5,R6,		
R1-R4,R7-R9	Resistor, 2.2 kilohm, 5%	
R18-R23,R32	Resistor, 4.7 kilohm, 5%	
R24-R31	Resistor, 5.6 kilohm, 5%	
R10-R17	Resistor, 100 kilohm, 5%	
C2-C4	Capacitor, 47 nanofarad, 63V, 20%	53160
C1	Capacitor, 22 microfarad, 10V	52596
TR1-TR3	Transistor, BC337	52961
IC1	IC, CD4074B or MM74C174B	53162
IC2,IC3	IC, CD4503B	52959
IC4	IC, 74LS32	52582
IC 404	IC, 2532	53202
	Standoff, Interface Cable Connector,	42392
	6.35mm x 15mm, 6-32	

NOTE: Parts without ESI numbers are commonly available as described in the parts list.

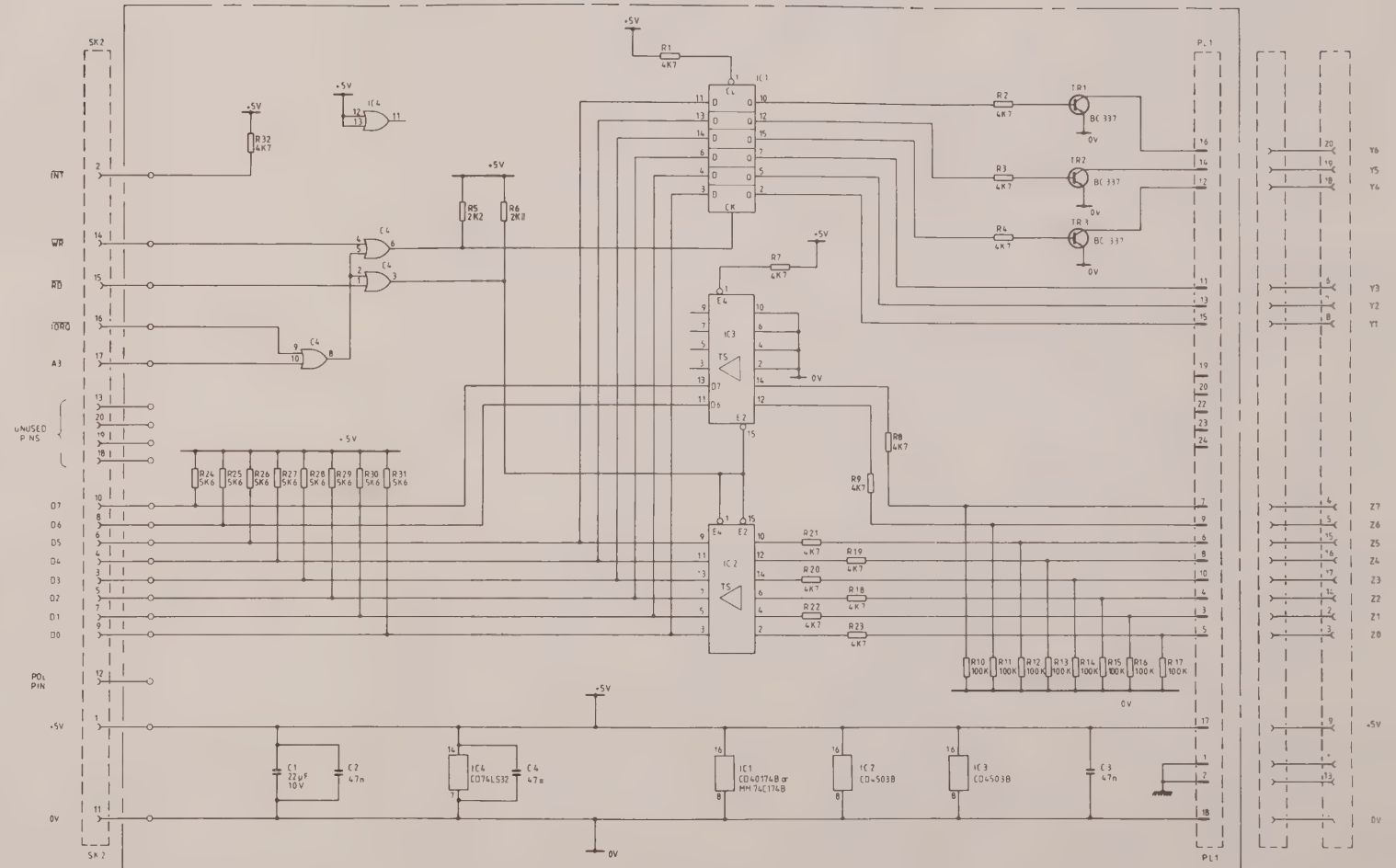
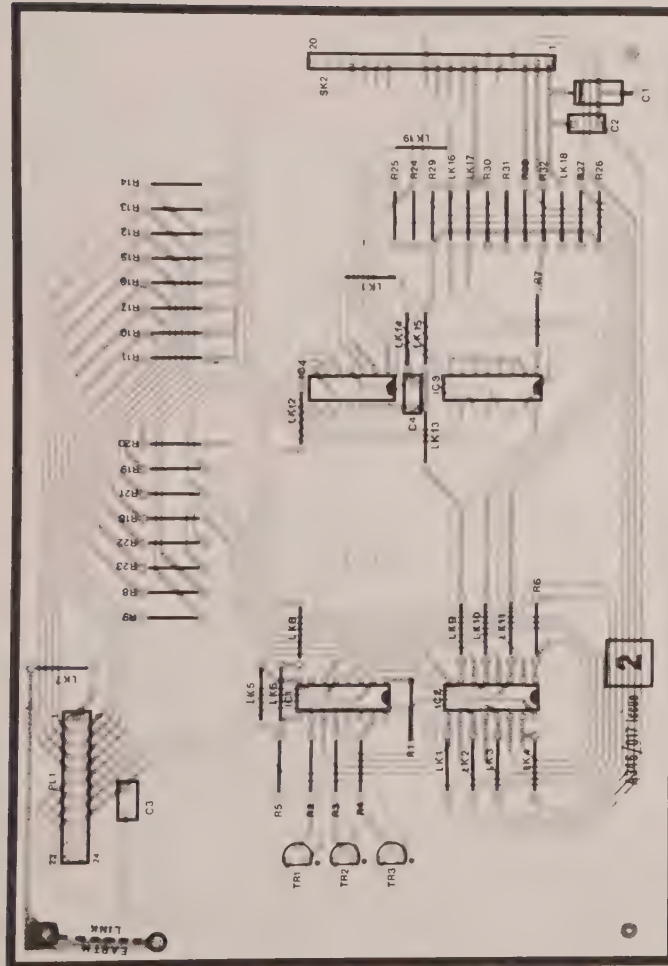


Figure 5-2. Interface Circuit Assembly

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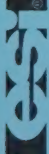
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☐ POOR ☐ AVERAGE ☐ GOOD ☐ EXCELLENT

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If NO, what would you add _____

6. Did the organization of the manual help you locate the information you needed?
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7. Were there too many or too few examples?

☐ TOO MANY ☐ TOO FEW ☐ ABOUT RIGHT

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☐ HARD TO UNDERSTAND ☐ AVERAGE ☐ EASY TO UNDERSTAND

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